MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

PEM0036 – CALCULUS

(Foundation in Engineering)

25 OCTOBER 2019
9.00 a.m. - 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **FOUR (4) pages** including cover page and appendix with **FOUR (4) questions** only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided. All necessary working **MUST** be shown.
4. Only non-programmable calculator is allowed.

QUESTION 1 [25 marks]

(a) For the function $f(x)=\dfrac{3-\sqrt{x^2-55}}{x+8}$, do the following:

(i) Find $\lim\limits_{x\to 8} f(x)$ (2 marks)

(ii) Use simplification method to find $\lim\limits_{x\to -8} f(x)=\dfrac{8}{3}$. (5 marks)

(b) Determine whether the following limits exist:

(i) $\lim\limits_{x\to 0}\dfrac{x-\sin x}{x^3}$ (4 marks)

(ii) $\lim\limits_{x\to \infty}\dfrac{e^x}{x^2}$ (4 marks)

(c) If $\lim\limits_{x\to -2}\dfrac{x^2+x-6}{x^2+5x+P}=\infty$, calculate the value of P. Next, state the vertical asymptote for the function. (3 marks)

(d) Consider the function $g(x)=\begin{cases}-x+a & x\le -2\\ x^2+b & x\ge -2\end{cases}$.

(i) If the function is continuous at $x=-2$ and $a=4$, find value b. (4 marks)

(ii) Check whether the function is continuous at $x=-2$, if $a=6$ and $b=3$. (3 marks)

QUESTION 2 [25 marks]

For the function $f(x)=3x\sqrt{36-x^2}$, find the following:

(a) Domain for the function. (2 marks)

(b) Extreme value(s) and where they occur. (7 marks)

(c) Intervals on which the function is increasing or decreasing. (4.5 marks)

(d) Inflection point(s). (11.5 marks)

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QUESTION 3 [25 marks]

Consider the functions of $f(x)=(x+2)^2$ and $g(x)=x+4$. Do the following:

(a) Sketch the graph for both functions. Indicate all intercept points. (3 marks)

(b) Use volume by washer method to evaluate the volume if the region bounded by both $f(x)$ and $g(x)$ is revolved about the $y=4$. (8 marks)

(c) Use shell method to verify your answer in (b). (14 marks)

QUESTION 4 [25 marks]

Solve the following differential equations and express your answer as an explicit equation:

(a) $\sqrt{x}\,\frac{dy}{dx}-3^{\sqrt{x}+y}=0$ (8 marks)

(b) $x\frac{dy}{dx}=\frac{1}{x}-3y+9$ (7 marks)

(c) $y''+3y'-28y=0;\qquad y(0)=20;\qquad y'(0)=-5$ (10 marks)

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APPENDIX

BASIC DIFFERENTIATION AND INTEGRATION FORMULAS

$$\frac{d}{dx}[\sin x] = \cos x \qquad \frac{d}{dx}[\cos x] = -\sin x$$

$$\frac{d}{dx}[\tan x] = \sec^2 x \qquad \frac{d}{dx}[\sec x] = \sec x \tan x$$

$$\frac{d}{dx}[\cot x] = -\csc^2 x \qquad \frac{d}{dx}[\csc x] = -\csc x \cot x$$

$$\frac{d}{dx}[e^x] = e^x \qquad \frac{d}{dx}[\ln x] = \frac{1}{x} \;;\quad x > 1$$

$$\frac{d}{dx}[sin^{-1}x] = \frac{1}{\sqrt{1-x^2}} \qquad \frac{d}{dx}[cos^{-1}x] = -\frac{1}{\sqrt{1-x^2}}\ for -1 < x < 1$$

$$\frac{d}{dx}[tan^{-1}x] = \frac{1}{1+x^2} \qquad \frac{d}{dx}[cot^{-1}x] = -\frac{1}{1+x^2}\ for -\infty < x < \infty$$

$$\frac{d}{dx}[sec^{-1}x] = \frac{1}{|x|\sqrt{x^2-1}} \qquad \frac{d}{dx}[csc^{-1}x] = -\frac{1}{|x|\sqrt{x^2-1}}\ \ for|x| > 1$$

$$\int \tan u\, du = \ln|\sec u| + C \qquad \int \sec u\, du = \ln|\sec u + \tan u| + C$$

$$\int \cot u\, du = \ln|\sin u| + C \qquad \int \csc u\, du = -\ln|\csc u + \cot u| + C$$

$$Area = \int_a^b [f(x) - g(x)]\ dx$$

$$Volume\ (Disk) = \pi \int_a^b [f(x)]^2\ dx$$

$$Volume\ (Washer) = \pi \int_a^b [f(x)]^2 - [g(x)]^2\ dx$$

$$Volume\ (\ Cylindrical\ Shells) = \int_a^b 2\pi(shell\ radius)(shell\ height)\ dx$$

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